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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

When the Weather Controls Lubrication

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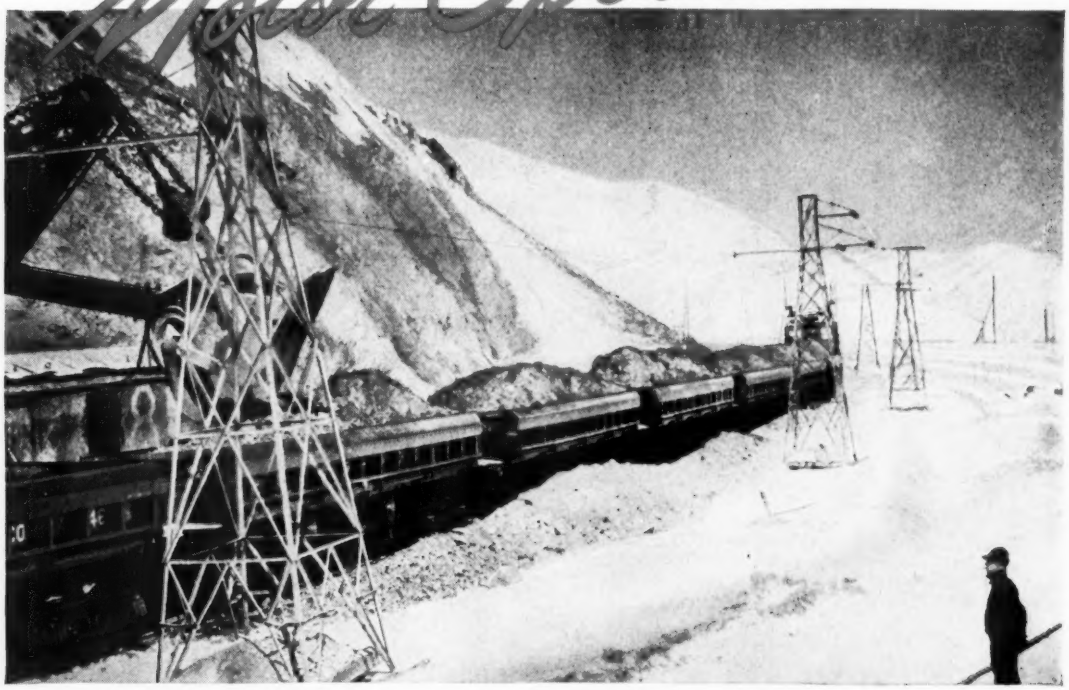
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

COLD WEATHER *Motor Operation*



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LUBRICATION

A TECHNICAL PUBLICATION DEVOTED TO THE SELECTION AND USE OF LUBRICANTS

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When the Weather Controls Lubrication

LAST SPRING the ore-carriers on the Great Lakes could not move any cargo before the middle of May, due to the ice jams around the Saulte Ste. Marie locks which are part of the water route from Lake Superior to the lower lake ports around Chicago, Detroit, Cleveland and Buffalo. That meant that iron ore reserves in the steel mills had to be sufficient to carry the blast furnaces over a crucial period of indeterminate length. It all depended upon the weather.

Next year it may be the same story, but next year the ore reserves will have to be greater for more steel must be rolled. War or peace will make but little difference; shells, tanks, ships, automobiles, reconstruction—all will require more steel than ever before.

That means that the ore-handling machinery—the shovels, cranes, car-dumpers and unloaders must work longer, harder and more dependably whenever the weather next winter will permit. Only ice and excessive snows can stop these massive machines, and then only by forming obstacles which interfere with manipulation. If they can be moved, their parts can be made to function.

LUBRICATION is a most decided factor in keeping material moving in cold weather. There is no more prevalent cause for interrupted operations than imperfect or insufficient lubrication. And yet, how often are production schedules planned with lubrication considered only as an afterthought?

In view of the fact that management is responsible for production, their interest should be centered quite as keenly upon lubrication as one of the most important adjuncts to machinery operations. The art of lubrication has been developed after years of intensive research and field study of machine requirements. The heavier the duty, the more severe are the bearing loads; the colder the temperature, the more care should be given to choosing gear and wire rope lubricants. This winter the demand for raw materials, ores, and coal will be more exacting than ever. The machinery for handling will function most dependably when the lubrication requirements are anticipated.

This making parts function in winter, however, can become quite a problem. It involves lubrication to a great extent. Accordingly, when cold weather approaches it is customary to consider temperature ranges, operating viscosities, pour tests and melting points, and choose lubricants accordingly. These latter should work, but oftentimes they cannot, due to conditions beyond control i.e., ice, snow, and the effect of cold upon metals and materials.

Quite naturally, outdoor machinery chiefly is affected by the weather. The cause back of the effect is low temperature and the freeze-ups which accompany same.

Freeze-ups must not be construed to involve only ice and snow. Lubricants "freeze" also in that they congeal to virtual solidity when exposed to sufficiently low temperatures for comparatively long periods of time. Metals also "freeze"—then they become brittle and break more easily when subject to impact or shock. In addition, "freeze-ups" due to water accumulation in lubricating systems can actually cause lubrication to cease. Then we have the added problem of wear and, subsequently, parts replacement.

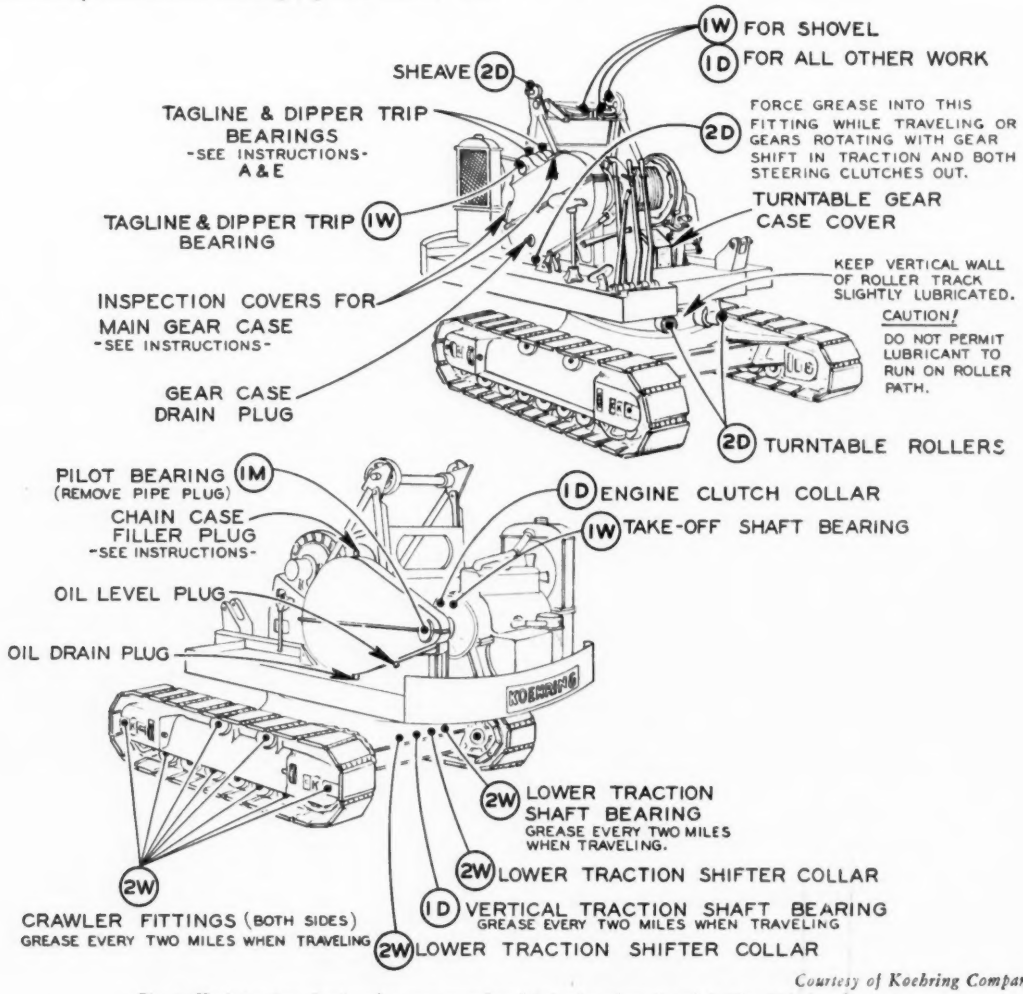
All this applies most particularly to machinery which cannot be housed or sheltered successfully against temperature changes. In other words, outdoor materials-handling machines.

Lubrication of such machinery must be approached according to the design of the parts. Fundamentally this means bearings, gears, chains, wire rope and the power plant. The manner in which these elements are assembled differs markedly from other types of industrial machinery. So do the loading conditions.

The loads imposed upon the moving parts become particularly severe when bulk materials must be handled which may have become frozen or snowbound. Then, when lubricants are sluggish, when fuses blow due to excessive starting load – then we must watch for faulty lubrication, for costly wear and increase in maintenance.

THE MACHINES

In reality, while the production management is interested chiefly in the amount of materials which can be moved, the engineering management must watch this item of maintenance in terms of unit cost per ton of materials handled. To realize the importance of lubrication, especially where machinery must operate under abnormally low temperatures or exposed to the rigors of winter weather, it will be advisable to review the basic constructional details.


1W FOR SHOVEL
1D FOR ALL OTHER WORK
SHEAVE 2D
TAGLINE & DIPPER TRIP BEARINGS -SEE INSTRUCTIONS- A&E
TAGLINE & DIPPER TRIP BEARING 1W
INSPECTION COVERS FOR MAIN GEAR CASE -SEE INSTRUCTIONS-
GEAR CASE DRAIN PLUG
2D FORCE GREASE INTO THIS FITTING WHILE TRAVELING OR GEARS ROTATING WITH GEAR SHIFT IN TRACTION AND BOTH STEERING CLUTCHES OUT.
TURNTABLE GEAR CASE COVER
KEEP VERTICAL WALL OF ROLLER TRACK SLIGHTLY LUBRICATED.
CAUTION! DO NOT PERMIT LUBRICANT TO RUN ON ROLLER PATH.
2D TURNTABLE ROLLERS
PILOT BEARING 1M (REMOVE PIPE PLUG)
CHAIN CASE FILLER PLUG -SEE INSTRUCTIONS-
OIL LEVEL PLUG
OIL DRAIN PLUG
1D ENGINE CLUTCH COLLAR
1W TAKE-OFF SHAFT BEARING
KOEHRING
2W LOWER TRACTION SHAFT BEARING GREASE EVERY TWO MILES WHEN TRAVELING.
2W LOWER TRACTION SHIFTER COLLAR
1D VERTICAL TRACTION SHAFT BEARING GREASE EVERY TWO MILES WHEN TRAVELING
2W LOWER TRACTION SHIFTER COLLAR
2W CRAWLER FITTINGS (BOTH SIDES) GREASE EVERY TWO MILES WHEN TRAVELING

Courtesy of Koehring Company

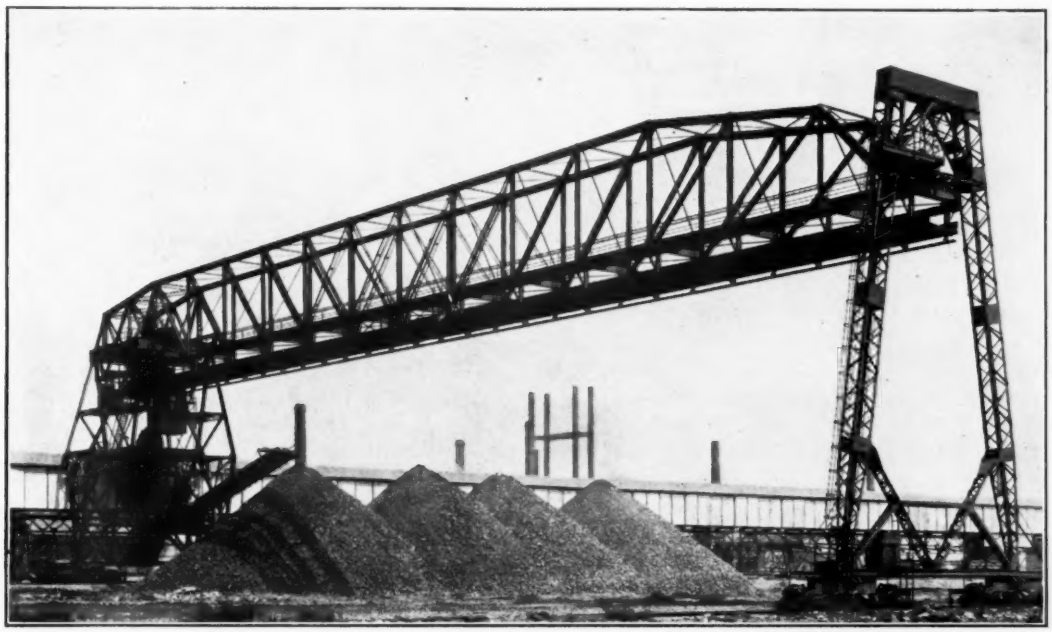
Fig. 1—Koehring has developed a very complete lubrication chart for their No. 304 shovel-crane dragline. Above are shown details for the powering turn-table and tractive elements. 1-D and 2-D mean respectively grease once or twice daily. 1-W and 2-W mean respectively grease once or twice weekly. 1-M means grease once every month. See manufacturers complete chart for further details.

Grab Bucket Handling

Wherever grab bucket handling of materials such as ore, coal or coke is feasible, the power shovel and drag scraper function. These materials are subject to outdoor storage, and until actually delivered to

blast furnaces, ovens or boilers, must remain in the yards or bins. They must be received, handled and stored so that a minimum of subsequent handling will be necessary.

During this procedure care of the machinery involved is necessary. This is essentially a matter of lubrication. In fact, the majority of the usual repairs or replacements can be attributed to lack of proper lubrication. There are a number of reasons for this. Such equipment is massive, many of the wearing elements such as gears, chains, bearings and wire rope are located in more or less inaccessible places, practically all are exposed to the weather, and dust or dirt are always present.



Courtesy of The Wellman Engineering Company

Fig. 2—A coal handling bridge indicating the exposure and scope of the operating machinery.

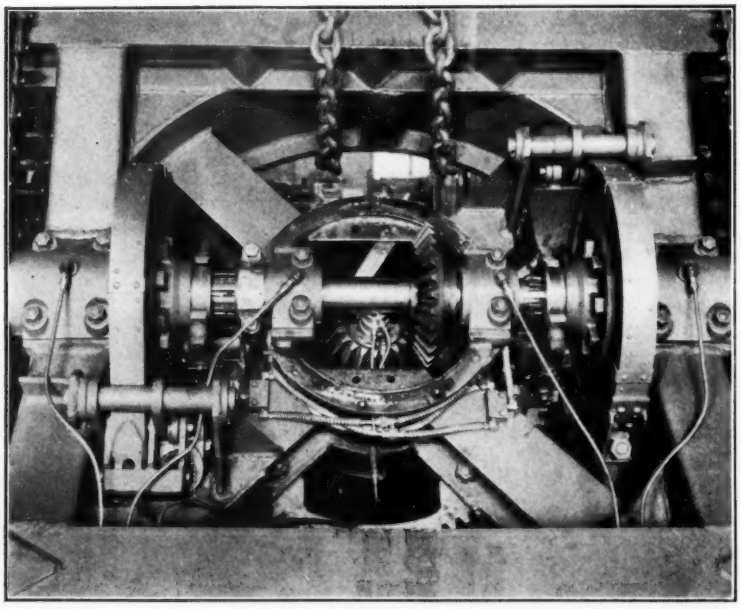
Power shovels are used in the open-pit mines for getting out the ore; also in many mill yards for storage handling. According to the class of service they are to be used for, they are customarily known as the revolving or the locomotive type. The principles of operation of both are similar, although the former is intended for lighter work, such as would be encountered in stripping jobs in mining, etc.; the latter, on the other hand, being equipped with an upper rotating base, is adapted to more heavy duty work.

The design requires a revolving frame or turntable which carries the hoisting boom or shovel arm, the power units and other operating mechanisms. A suitable carrying frame or truck may be equipped with standard railroad wheels or mounted on a truck fitted with broad traction wheels of the trackless type, or a caterpillar tractor device. In practically every case the machine is self-propelling. The revolving frame is carried on roller bearings or cone rollers which travel on a suitable swinging gear casting securely attached to the truck frame.

The number of engines or motors required for the efficient operation of a power shovel, hoist, or drag-scraper depends upon the size of the machine. Some smaller machines will have two power units located at right angles to each other, the various crane, shovel and scraper operations being performed by means of clutches. Others will be equipped with only one gasoline or Diesel engine. For larger units, however, separate engines or motors may be provided to perform the travelling, swinging, hoisting and thrusting operations. Here the hoisting element controls the rise and fall of the shovel or dipper. The swinging engine or motor involves the turntable and the thrusting unit operates the shovel or drag in the process of digging or initial removal of the materials. While many builders install these engines on the turntable itself, some will locate the crowd or thrusting power element on the boom.

Yard Storage

The crane is less mobile than the shovel, but often can handle much heavier loads. It is flexible and capable of handling and locating its loads with uncanny accuracy. It involves an assemblage of electric motors, bearings, gears and wire ropes.



Courtesy of Harnischfeger Corporation

Fig. 3—Underside view of a P & H Model 655A excavator with gear housing removed showing propel gearing and mechanism. Note connections for lubrication at vital points.

In average service, the principles of operations are essentially the same regardless of whether the jib, gantry, railroad or overhead crane is involved, i. e.:

Electric motors serve to move the crane proper, to manipulate the trolley along the bridge and to rotate the hoisting drums.

Gears bring about the necessary speed reductions.

Bearings carry the gear and pinion shafts, trolley wheels journals and motor armatures.

Wire ropes or cables carry the hoisting devices.

In some one of the above forms the crane is a vital factor in practically every industry where bulky materials or products must be moved with precision, rapidity and expedience.

In the steel mill it is the primary means of moving the product from stage to stage. The ladle crane handles molten metals; the ingot stripping crane removes ingots from their moulds; the ingot charging cranes are used in connection with the soaking or heating pits; open hearth furnace charging cranes arrange the charge; and the transfer crane moves steel plates and shapes from cooling racks to storage and thence to cars or boats for shipping.

Crane Service

Cranes are often subjected to wider ranges of temperature than shovels, unloaders or car dumpers since cranes may operate both indoors and outdoors, often running in and out of cover many times a day. So it is difficult to standardize lubrication for all the cranes on any property. For example, where the charging crane in an open hearth or soaking pit building may be subjected to abnormally high radiated heat, the overhead travelling crane in the storage yard may be exposed to the same conditions as the ore bridge.

Accordingly, if a 1000 second viscosity gear lubricant is suitable for ore bridge gears, on the same premise a 2000 seconds viscosity lubricant might well be assumed to be best for all crane gears; the higher average operating temperatures being the basis for this assumption.

In cold weather service, however, it is well not to go by average conditions. Too many variables are involved. Where one crane may operate under cover in an atmospheric temperature of 100 degrees Fahr., directly adjacent there may be a similar device in the yard, operating exposed to the weather. It is really fair to neither to attempt to standardize bearing, gear or wire rope lubricants to serve them both. Certain of the wearing elements of one or the other will be bound to suffer. This is especially true in the North where marked temperature differences may be involved during the course of a winter.

Bearing lubrication, for example, under such conditions, on an outdoor crane, may require oils of low pour test and comparatively low viscosity to insure the maintenance of an effective lubricating film, and to reduce the possibility of congealment in the oil reservoirs. Here, an oil of at least zero pour test and from 100 to 200 seconds Saybolt viscosity at 100 degrees Fahr., would be required.

On the other hand, low pour test is of but little consequence where the machine is operating under cover and where the buildings are heated to some extent. Furthermore, a somewhat heavier oil will be necessary, especially if the crane operates adjacent to heat appliances, furnaces, etc. In other words, it becomes necessary to give this matter of viscosity careful consideration. We should remember that where one oil might be ideal for one condition, in another it might be relatively incapable of furnishing lubricating films of the requisite viscosity. Experience is the best guide as to the oil which should be used. Figure 5 shows typical viscosity ranges which have been found to be practicable.

ORE HANDLING AT THE STOCK PILE

The ore bridge is a glorified crane which usually covers a wide area as it is the key mechanism in connection with the ore reserve stock-pile.

The unloader is specifically a machine for rapid unloading of ore boats.

The ore bridge consists of a frame which is mounted on suitable end trucks or carriages; a runway or track for these latter to travel over; an overhead trolley capable of travelling along the bridge, and a grab bucket or electromagnet arrangement which operates from the end of the trolley.

That part from which the hoisting device operates on the unloading bridge is often either hinged to form a jib, or arranged so as to telescope within the main structure of the bridge. This enables operation of the hoisting mechanism between the masts of ships or other obstacles and facilitates manipulation in the holds.

The automatic unloader also is widely used for unloading ore and coal from the holds of vessels. This device comprises a main framework which is mounted on trucks in a similar manner to a crane bridge. These trucks run along trackwork or runways on the wharf, enabling movement of the entire frame.

On the bridge or framework is mounted a trolley which carries a balanced walking beam. From the outer or hoisting end of this latter is suspended a rigid hoisting leg with a grab bucket at the bottom. Within this leg are located the bucket operating gears, chains and other mechanism pertinent to horizontal motion. Vertical movement is brought about by operation of the walking beam.

This facilitates a three-way motion which enables the operator to locate the bucket readily and accurately with respect to the hatch of a vessel and to hoist with a maximum of delivery. In other words, after locating the bridge, the trolley or hoisting mechanism can be moved along the bridge until the grab bucket or magnet is above the product. It can then be lowered, filled or charged, and raised, to be discharged, after moving along the bridge according to the location of the point of discharge.

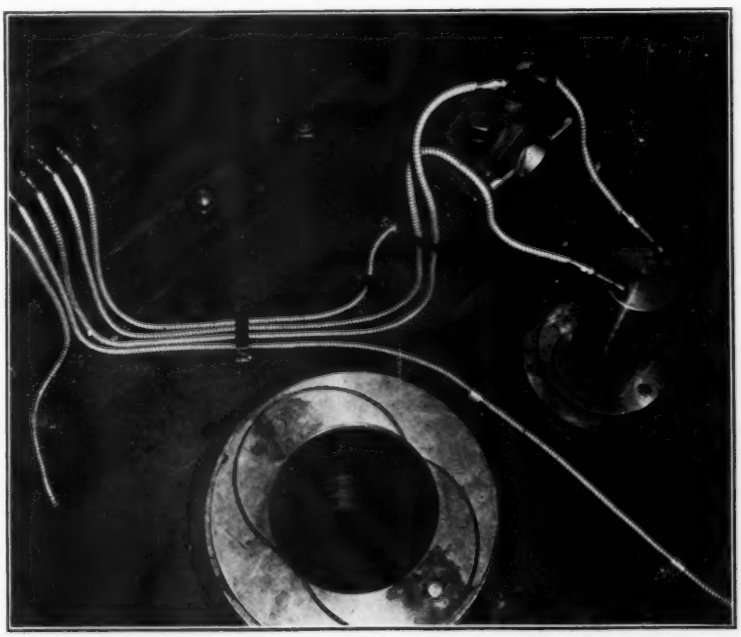
The Ore Bridge and Unloader Always Are Exposed

While the electric crane will frequently have the advantage of being located under a housing, with the result that its wearing parts may be protected to some extent from the elements, the ore bridge and unloader will, as a rule, be located in the open.

This means that lubrication of the operating mechanism must be carefully watched in cold weather. It becomes a matter of counteracting the effects of detrimental weather conditions by means of oils, greases and gear and wire rope lubricants which are capable of functioning under these conditions.

It is especially important that all lubricants which may be exposed to the action of rain or sleet, be sufficiently adhesive to resist water-wash. This will pertain particularly to wire rope and exposed gears. Furthermore, many of these parts will be located in more or less inaccessible or hazardous places which may be neglected by some operators in the interests of personal safety or convenience.

In consequence, gear, wire rope and bearing lubrication on such equipment will differ markedly from that involved under the more favorably housed conditions which prevail in many other industries. Then again, there will always be a certain amount



Courtesy of Harnischfeger Corporation

Fig. 4—A portion of the upper deck machinery of a P & H electric shovel with propel gearing removed to show arrangement of lines from centralized lubrication station to points of lubrication in this area.

of abrasive foreign matter or dust in the air which will have a tendency to cause scoring and abnormal wear by contaminating lubricants.

But few provisions for bath or enclosed lubrication are possible on many of these mechanisms. The lubricants, therefore, must be durable and capable of giving extra protection. Even so, it is not enough to be careful in initial selection. Equally as careful attention in application is necessary. For this reason progressive plants, as a rule, will insist on a regular lubrication schedule, in many cases holding individual operators directly responsible for the production and efficiency of the machines they are operating.

LUBRICATING WIRE ROPE IN COLD WEATHER

Wire rope is probably the most important single factor in hoisting or materials handling. By its strength it indicates the load which can be handled. By its condition it indicates the extent of lubrication and indirectly its dependability.

Wire rope is deceptive. Viewed in service as it runs over sheaves or drums, or swings its load, it seems to be most flexible. This is true for long sections. Shorter lengths are relatively stiff. In cold weather this stiffness is increased. Yet it is by virtue of the flexibility that the core and inner steel strands are kept re-lubricated and capable of flexing against one another without undue wear. Furthermore, under low temperatures some lubricants will tend to chip or crack. This will lead to exposure of more or less of the rope surface and enable moisture to penetrate and cause rusting, corrosion and wear. Obviously the purpose should be to prevent such a condition by careful choice of a type of lubricant which has been especially prepared to develop the necessary cohesion and adhesion at low temperatures.

The primary purpose of wire rope lubrication is to prevent rusting of the wires and to retard wear by reducing friction as far as possible. A rope with one or two broken strands due to rusting or wear may not only cause a tie-up of the entire machine if such strands interfere with the operation of sheaves, or other companion cables, but may also present a distinct hazard. Any wire rope in such condition is just that much weaker and less capable of handling the imposed loads.

Friction and wear are continually occurring be-

LUBRICATION GUIDE FOR MATERIALS HANDLI

The Machines	*The Mechanism*	*The Means of Lubrication*	
	Bearings—Motors, Etc.		
	Sleeve Type— oil lubricated	Sight feed cups Waste pads Ring Oilers	St Mi
		R. R. Journal Boxes	Ca Oil
	grease lubricated	Pressure gun or compression cup	Ca Gr NL No.
	Ball or Roller oil lubricated	Self-circulation; bearings sealed	St Mi
	grease lubricated	Hand packed or pressure gun	Spe al rad NL No.
CRANES, POWER SHOVELS UNLOADERS, ORE BRIDGES, CAR DUMPERS, LIFTS	*Gears*		
	Enclosed	Bath lubricated	Ge Lu
	Exposed	Bath lubricated	Ge Lu
	Exposed	Hand lubricated	Li Mec
	Exposed to water	Hand lubricated	Co pou
	Wire Rope		
	general service	Hand or swab	St Mi
	exposed to water	Hand or swab	Co pou
	Gasoline Engines	See ENGINE LUBRICA	
	Diesel Engines	See ENGINE LUBRICA	
	Steam Engines		
	Cylinders	Mechanical or Hydrostatic	Co pou
	Bearings and guides	Sight feed oiler; hand oiled	St Mi

tween the wires and strands of any wire rope. There is also a tendency to squeeze out any contained lubricant, especially when the ropes pass over sheaves or around drums. The renewal of lubricant is, therefore, an absolute necessity regardless of how effectively the core may have been saturated with lubricant when the rope was laid up.

There is but little difference between friction as it occurs between the wires of a wire rope and friction between a bearing and shaft. This can be overcome only by effective lubrication, brought about by the proper application of a suitably prepared wire rope compound, which will be capable of not only penetrating to the innermost strands and core of the rope, but also sufficiently adhesive and viscous to resist being prematurely squeezed out or washed off.

A good rope lubricant also must resist any tendency to cake, gum or ball up, especially if contaminated with an excess of dust, dirt or metallic particles. Furthermore, it must not thin down too much if exposed to high temperatures. This involves the viscosity or relative fluidity. While it is a guide which is useful in purchasing, viscosity is not indicative of quality or lubricating ability. How the lubricant functions, penetrates and sticks under actual operating conditions is the best indication of its suitability.

The Viscosity Range

The viscosity of a wire rope lubricant should range from 400 to 1200 seconds Saybolt at 210 degrees Fahr. according to the operating temperatures that may be involved and the extent to which it may be exposed to water.

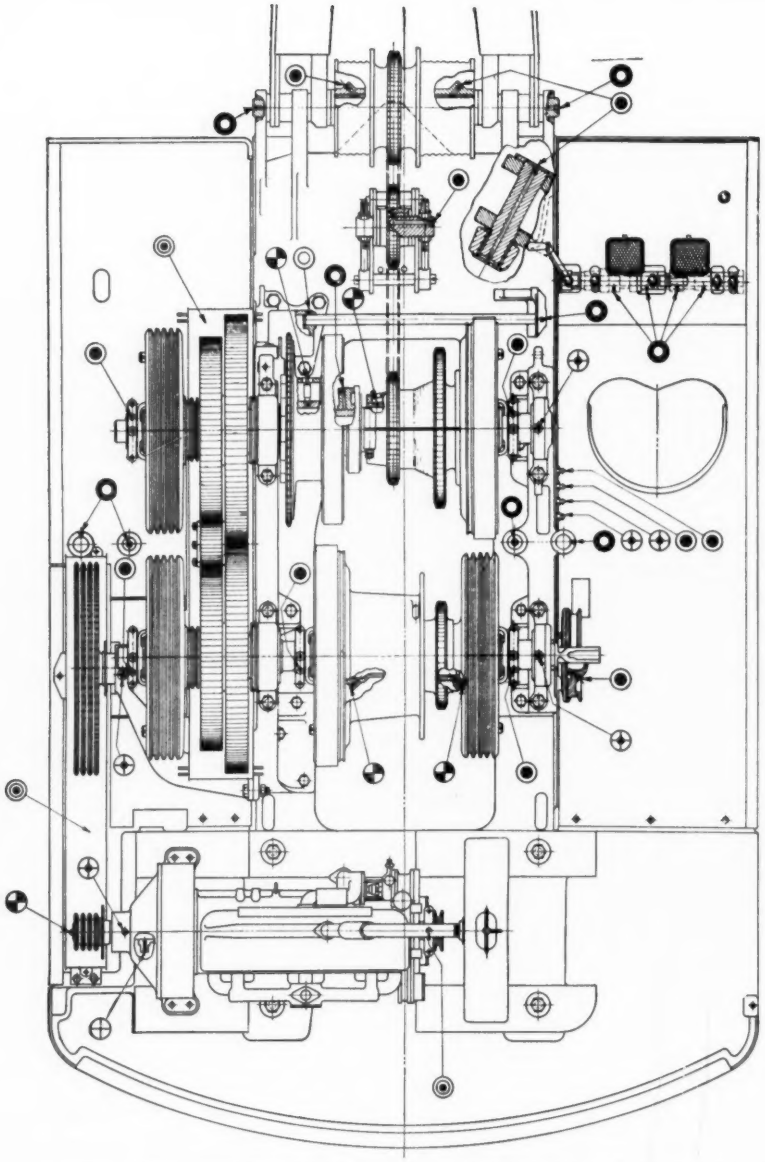
In crane service adjacent to ovens, furnaces or open hearths, etc., where the lubricant might thin down sufficiently to drop off to perhaps result in lack of lubrication, it will be advisable to regard the maximum temperature prevailing as the criterion in selecting the lubricant. Conversely, for continued cold weather operation, in service around the Great Lakes, in Canada or the Northwest, it will normally be advisable to use a lubricant of around 500 seconds viscosity to be assured of easy application and adequate ductility and resistance to cracking or chipping.

Nature of the Product

To meet these requirements, wire rope lubricants should, in general, be straight mineral petroleum products, or compounded with special materials to increase their adhesiveness and resistance to waterwash where this is

NDLI MACHINERY OUTDOORS IN COLD WEATHER Fig. 5

ion	Type of Lubricant	Viscosity Seconds Saybolt Univ. 32° F.	100° F.	210° F.
	St Min. Oil (32° F. or above)	4,000—9,000	200—325	
	(below 32° F.)	1,300—4,000	100—225	
	Ca Oil (Winter) or (All-year)	2700 Max.	300 Max.	
	Cu Grease NLGI Grease Consistency No. 1)			
	St Min. Oil (32° F. or above)	2,000—3,200	150—225	
	(below 32° F.)	950—2,000	100—160	
	Spl al Ball and Roller Bearing rade— NLGI Grease Consistency o. 1 and 2)			
	Ge Lub. Automotive Type	33,000	800—1,500	70—190
	Ge Lub. Automotive Type	60,000		120—200
	Lt Med. Industrial Gear Lub.			450 (Approx.)
	Co pounded Industrial Gear Lub.			1,150 (Approx.)
	St Min. Rope Lubricant			600 Max.
	Co pounded Rope Lubricant			1,200 Max.
E LUB	CATION CHARTS			
E LUB	CATION CHARTS			
atic	Co pounded Cyl. Oil	60,000—100,000		100—150
	St Min. Engine Oil	4,000—9,000	200—325	



Greasing Table			
◉	TWICE A SHIFT	⊕	ONCE EVERY 20 SHIFTS
●	ONCE A SHIFT	◕	ONCE EVERY 60 SHIFTS
⊕	ONCE EVERY 5 SHIFTS	◎	OIL AS REQUIRED

Courtesy of Bucyrus-Erie Company

Fig. 6—An interesting lubrication table prepared by Bucyrus-Erie for a heavy duty shovel. The frequency is based on an average 8-hour shift. More intensive operation may require more frequent attention.

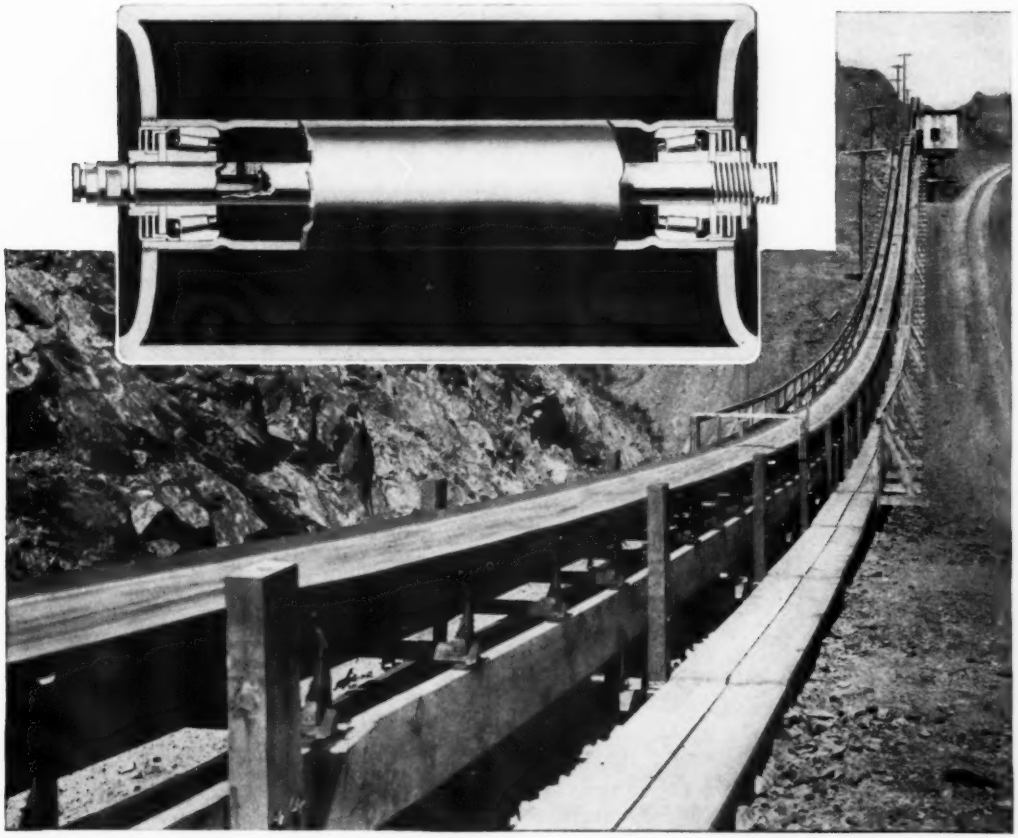
essential. The viscosity should be an inherent property of the lubricant, not an artificial characteristic developed by fillers or thickening materials which might be affected by temperature change or contamination.

Application

In cold weather service, wire rope lubricants can best be applied hot. This will reduce the viscosity temporarily and facilitate handling.

Penetration of lubricant to the core is the secret of proper wire rope lubrication. Where it is effectively brought about, the wear between the internal strands will be markedly retarded. It is this latter which is so definitely related to rope life. Furthermore, if adequate penetration is attained, protection of the external surfaces will be automatically assured.

Exposed wire rope on steel mill cranes, mine hoists and around the ore docks can be effectively lubricated by using a split box through which the rope can be run. Such a box can be built with suitable provision for rendering it sufficiently tight to prevent the lubricant from leaking out, even when reduced in viscosity by heating. The slow passage of the rope through such a bath of heated lubricant will insure that not only will the surface be coated, but also that the requisite penetration takes place to the inner strands. Further working of the rope over the sheaves before the lubricant has time to cool entirely will bring about maximum penetration and re-saturation of the core.



Courtesy of Chain Belt Company

Fig. 7—A section of the world's longest belt conveying system with details of one of the idlers. Normal lubrication frequency is from 30 to 90 days depending on the intensity of operation. This system has a capacity of 1100 tons an hour at a speed of 550 feet per minute.

PLANNING FOR LUBRICATION

It is fortunate that current practice in providing for lubrication of materials-handling machinery begins on the drafting board, by designing for adequate and accessible lubrication when the machinery is in the development stage. This is a most economical procedure for it enables concealment of oil circulation piping, handy location of grease fittings, and other features which will reduce the possibility of damage to lubricating equipment and as-

sure better protection in cold weather.

The modern machine designer places the true value upon lubrication, to the extent that automatic lubrication has come to be rightfully accepted as a necessity, particularly where intricate mechanisms are involved. Failure, due to abnormal wear, obviously would entail considerable expense, loss of time, or interruption of production schedules.

It is impossible to prevent any earth-moving or ore-handling machine from coming in contact with abrasive foreign matter. Accordingly, the designer may be justified in giving some of the parts less consideration than he would others which can be installed apart from dust or dirt and the detrimental effects of water or widely varying temperature conditions. This should never be done, on the other hand, until cost of housing, seals, or other means of protection have been studied and the probable benefits weighed against this first cost.

Lubricant Refinement Depends Upon Design

Design must, therefore, be given consideration in deciding upon the degree of refinement essential in a lubricant. Wherever the design of bearings, gears, chains or other moving parts on a shovel or crane is such that they must function comparatively exposed, if it is impracticable to prevent drip or waste, a cheaper grade of lubricant can normally be recommended than where such conditions do not exist. In other words, there is a relationship between design and lubricant refinement. But in any event, the lubricant must flow or be applicable in cold weather.

An ordinary grade of lubricant may not possess the same lubricating ability as a more highly refined product; on the other hand, the use of the latter under such conditions would not be economical nor an assurance of any better lubrication, due to the fact that it might become unduly contaminated, with consequent reduction in its original lubricating ability. Furthermore, an initial high cost would not be justified where drip or premature waste cannot be prevented. Correction of structural conditions is the logical procedure if this is to be overcome.

A condition involving waste should never be accepted. Every endeavor should be made to correct it if it can be accomplished without abnormal expense. This will be especially true under conditions which may cause contamination of lubricants during service, for the attendant possibility of damage or abrasion of moving parts is serious when materials in volume must be kept moving.

Waste can be prevented in many ways, dependent upon the design of the equipment, the duty involved and the location. Frequently slight changes in design may solve the problem. For example, it may be practicable to enclose some gears in sheet metal housings, and to install bearing guards which will reduce materially the extent to which lubricants may be contaminated. By this prevention of contamination the durability and life of such products can be extended with marked results in economy.

It will always be beneficial for the lubricating engineer to study design from this point of view. If existing conditions cannot be corrected, it is then his duty to decide upon grades of lubricants commensurate with the existing operating conditions.

It is, therefore, more or less of an ideal to prepare a theoretical lubrication recommendation for any specific type of machine without complete knowledge of the operating conditions. Normally it would have to be based upon modern design and the assumption that the builders have realized the importance of lubrication and the necessity for protecting the moving parts as much as possible. As a result, whereas a very high grade of grease or a filtered straight mineral oil might be adaptable to such a type of design, in the case of an older machine it might be necessary to substitute an entirely different type of lubricant to meet the existing constructional conditions, and the nature of the operations.

HOW LUBRICATION AFFECTS MAINTENANCE

Maintenance, as it may involve parts replacement, is directly related to lubrication, for it is the result of wear, attributable in many cases to the use of unsuitable lubricants, or contamination in service. It is not always practicable to obtain the most suitable product for a job; furthermore, limitation of the means for handling might prevent its most effective application. Likewise, contamination may sometimes be beyond the control of the operator. One must never forget, however, the subsequent price he may have to pay in the form of increased maintenance and repair costs.

For this reason, the mechanical condition of machinery with respect to wear of moving parts, and development of more or less misalignment may often make it advisable to consider specialized lubrication quite foreign to the type of lubrication originally provided for by the designer. This will be true where maintenance has been neglected or where a grade of lubricant has been used which is unsuited to the means of application, the operating speeds, temperature, or load.

Extra Film Strength

In the operation of certain type of gears and roller bearings, involving steel working against

steel, misalignment and uneven wear may often cause marked increase in unit bearing pressure, thereby making it advisable to consider the use of a lubricant capable of forming a protective film of unusual strength. Provided the design is such as to enable retention of this lubricant at the point of maximum load, there will be a certain amount of added insurance that wear and clearance increase will be retarded.

Unfortunately, where misalignment of either gears or bearings has occurred, it is very possible that leakage of lubricant will result and the beneficial effect of the lubricant cannot be obtained. Under such conditions it is obvious that the expected benefits of extra-film strength may not be fully realized, in view of the inability of the lubricant to remain for a sufficient length of time between the contact parts.

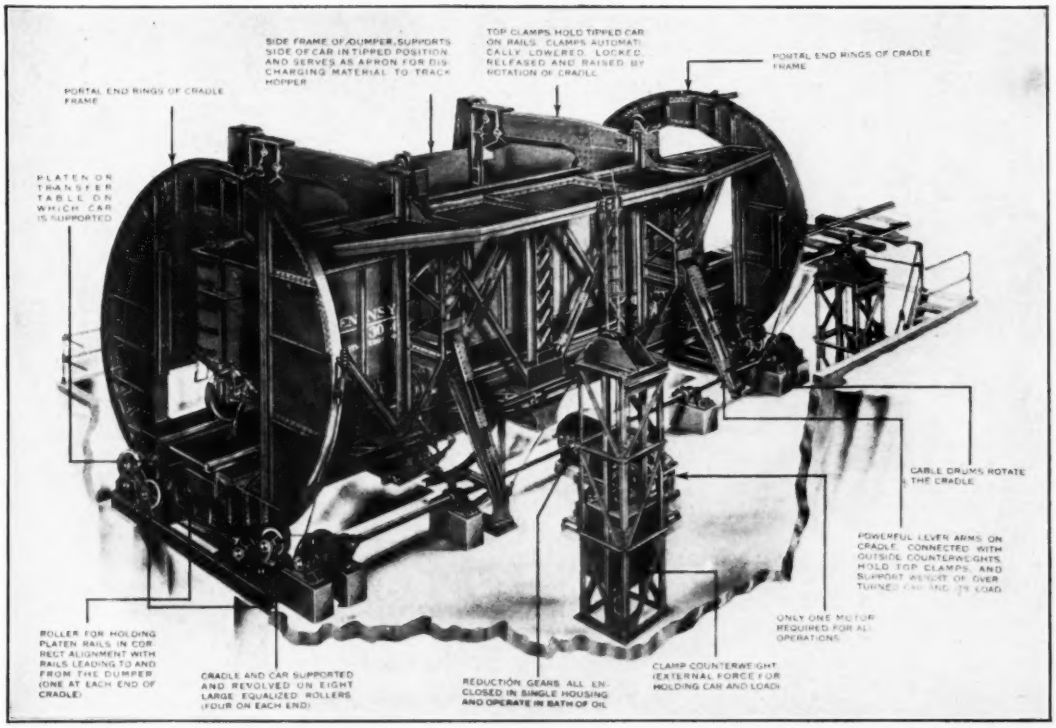
By adopting a repair program which will correct mechanical defects detrimental to effective lubrication, the economical use of lubricants can be more easily accomplished and more permanently maintained. Many improvements in bearing design, power transmission equipment, and methods of lubrication have been made.

In addition research in the petroleum industry has proved the practicability of manufacturing both lubricating oils and greases to more nearly meet the mechanical requirements of machine design. Correlation of these improvements to the benefit of plant production schedules, and reduction in cost of maintenance, should appeal to every operating executive.

INSPECTION PROCEDURE

Inspection of heavy machinery should be made with the full cooperation of the installation engineer of the machinery builder. The routine to follow requires consideration of alignment, bearing clearances, means of sealing to prevent entry of water or non-lubricating foreign matter, the adaptability of the lubricating equipment to the operating requirements and the location and accessibility of the latter.

Assurance that the lubricating system can be depended upon positively to deliver the required amount of oil or grease to the moving parts of the machinery in question is absolutely essential. In making primary inspection this should never be overlooked, for no matter how perfect the bearings, piston ring fit, or sealing devices, if there is any possibility of impaired flow or distribution of lubri-


SIDE FRAME OF DUMPER, SUPPORTS SIDE OF CAR IN TIPPED POSITION AND SERVES AS APRON FOR DISCHARGING MATERIAL TO TRACK HOPPER
TOP CLAMPS HOLD TIPPED CAR ON RAILS. CLAMPS AUTOMATICALLY LOWERED, LOCKED, RELEASED AND RAISED BY ROTATION OF CRADLE
PORTAL END RINGS OF CRADLE FRAME
PORTAL END RINGS OF CRADLE FRAME
PLATEN OR TRANSFER TABLE ON WHICH CAR IS SUPPORTED
CABLE DRUMS ROTATE THE CRADLE
POWERFUL LEVER ARMS ON CRADLE, CONNECTED WITH OUTSIDE COUNTERWEIGHTS, HOLD TOP CLAMPS, AND SUPPORT WEIGHT OF OVERTURNED CAR AND ITS LOAD
ONLY ONE MOTOR REQUIRED FOR ALL OPERATIONS
ROLLER FOR HOLDING PLATEN RAILS IN CORRECT ALIGNMENT WITH RAILS LEADING TO AND FROM THE DUMPER (ONE AT EACH END OF CRADLE)
CRADLE AND CAR SUPPORTED AND REVOLVED ON EIGHT LARGE EQUALIZED ROLLERS (FOUR ON EACH END)
REDUCTION GEARS ALL ENCLOSED IN SINGLE HOUSING AND OPERATE IN BATH OF OIL
CLAMP COUNTERWEIGHT (EXTERNAL FORCE FOR HOLDING CAR AND LOAD)

Courtesy of Link-Belt Company

Fig. 8—Details of a Link-Belt rotary railroad car dumper showing the operating mechanisms. Careful lubrication of the equalizer rollers is especially important.

cant, serious wear may develop to cause disruption of production schedules and require costly repair.

Where pressure circulating oiling systems are involved, such an inspection will be particularly advantageous, for initial operation will always tend to lead to the accumulation of a certain amount of non-lubricating, foreign matter. Such foreign matter may be composed of core sand, or fine metallic particles developed during the wearing-in period.

If oil is circulated in sufficient volume under adequate pressure, or if grease is periodically delivered under comparatively high pressure, there are involved, should be studied with the utmost care. In contrast, gears require only inspection of the gear teeth to make sure that the proper amount of lubricant is being delivered to prevent scoring, scuffing or abnormal wear.

Ball and roller bearings in turn should be subjected to a regular schedule of re-lubrication, and cleaning where the operating conditions or seal may allow foreign matter to gain entry. This schedule should be planned by consulting with the engineers of the bearing, machine and lubricant manufacturers.

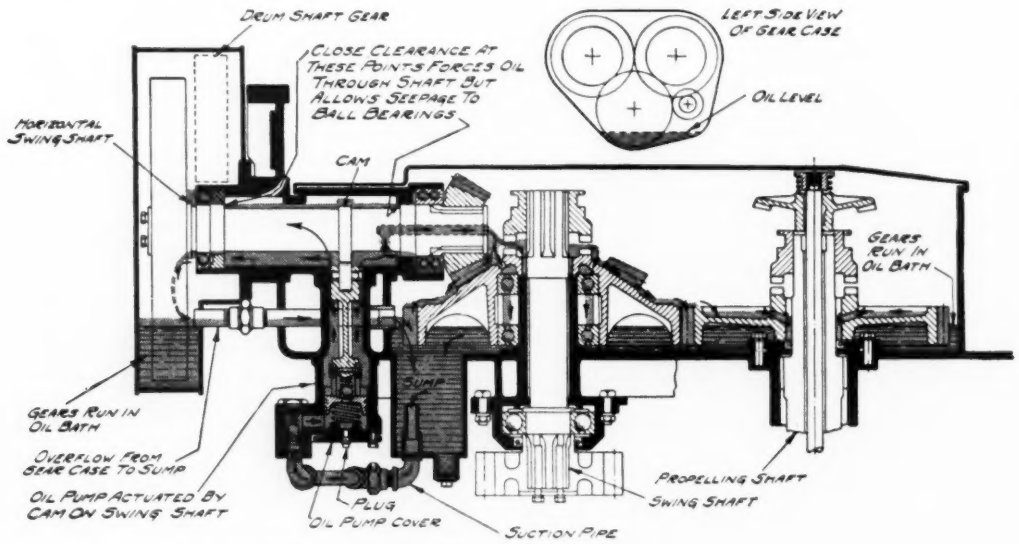

DRUM SHAFT GEAR
CLOSE CLEARANCE AT THESE POINTS FORCES OIL THROUGH SHAFT BUT ALLOWS SEEPAGE TO BALL BEARINGS
LEFT SIDE VIEW OF GEAR CASE
OIL LEVEL
HORIZONTAL SWING SHAFT
CAM
GEARS RUN IN OIL BATH
SUMP
GEARS RUN IN OIL BATH
OVERFLOW FROM GEAR CASE TO SUMP
OIL PUMP ACTUATED BY CAM ON SWING SHAFT
PLUG
OIL PUMP COVER
SUCTION PIPE
PROPELLING SHAFT
SWING SHAFT

DIAGRAM OF CONTINUOUS FLOOD OIL LUBRICATION OF GEARS AND BEARINGS FOR SWING AND PROPELLING MACHINERY AND DRUM SHAFT GEARS ON REVOLVING FRAME
(PROPELLING SHAFT SWUNG 90° FOR PURPOSE OF ILLUSTRATION)

Courtesy of Bucyrus-Erie Company

Fig. 9—Details of a Bucyrus-Erie continuous lubrication system as applied to heavy duty shovel gears.

will be little tendency for such foreign matter to accumulate within bearing clearances or oil grooves.

Where grease is employed, such materials will, in all probability be forced out through the ends of the bearings. In the average motor or engine oiling system, however, such foreign matter will normally be carried back to the sump, from which it can be removed at the cleaning period.

At the same time bearings should be checked for misalignment. The possible entry of water should also be carefully checked. Water, along with metallic particles, may lead to development of sludge formation or freezing. It is the forerunner of impaired lubrication and clogging of the lubricating system.

Bearing wear, particularly where plain bearings

CONCLUSION

Materials handling in bulk used to require coordination of ideas with regard to machine maintenance and cost of replacement parts. Today it is not so much a matter of cost of these parts as where and when to obtain them. There is no final solution to the maintenance problem, it will be with us always, and will be most aggravating in cold weather. But there is a partial preventive in the form of better lubrication. This is not an ideal with modern heavy duty materials handling machinery, it is assured if there is common sense appreciation of operating requirements, if means and methods of lubrication are understood, if lubricants are selected to meet seasonal conditions rather than price.

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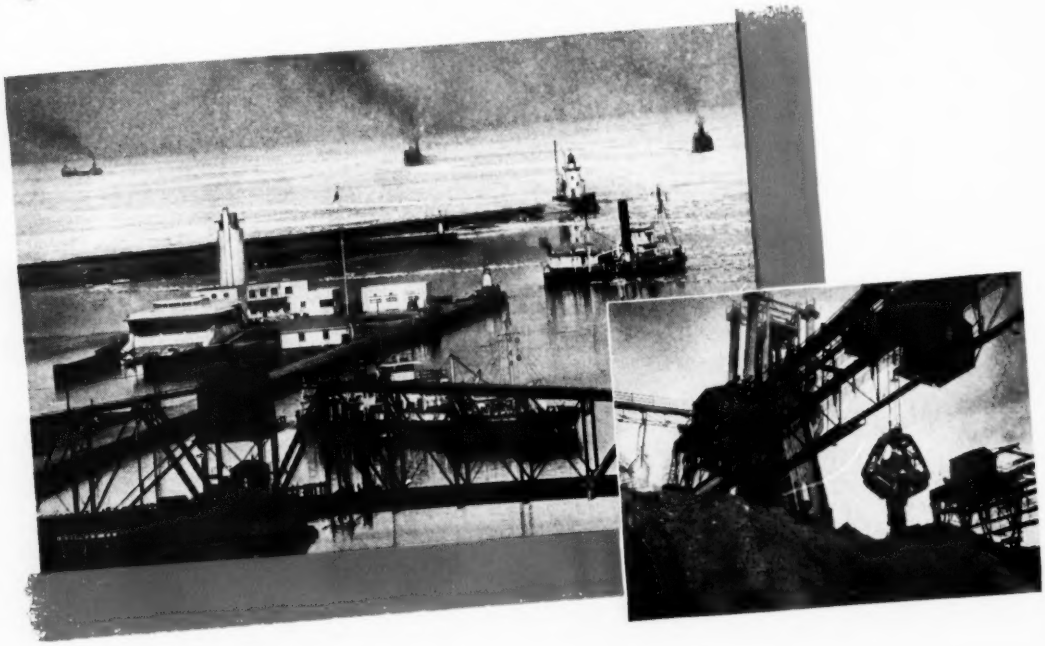
TEXACO LUBRICATION GUIDE

MATERIALS HANDLING MACHINERY OUTDOORS IN COLD WEATHER

THE MACHINES	THE MECHANISM	METHOD OF LUBRICATION	TEXACO RECOMMENDATIONS
CRANES, POWER SHOVELS, UNLOADERS, ORE BRIDGES, CAR DUMPERS, LIFTS	**Bearings—Motors, Etc.**		
	Sleeve Type — Oil lubricated	Sight feed cups, Waste pads, Ring Oilers — 32° Fahr. or above	Cetus or Alcaid Oil
		Sight feed cups, Waste pads, Ring Oilers — Below 32° Fahr.	Spica or Cetus Oil
		R.R. Journal Boxes	Car Oil Winter or Texayce Oil
	Grease lubricated	Pressure gun or compression cup	Cup Grease No. 1
	Ball or Roller		
	Oil lubricated	Self-circulation; bearings sealed — 32° Fahr. or above	Capella Oil B or C
		Self-circulation; bearings sealed — Below 32° Fahr.	Capella Oil A or B
	Grease lubricated	Hand packed or pressure gun	Starfak Grease L or M
	Gears		
	Enclosed	Bath lubricated	Thuban 90
	Exposed	Bath lubricated	Thuban 140
	Exposed	Hand lubricated	Crater No. 0
	Exposed to water	Hand lubricated	Crater No. 1X
	Wire Rope		
	General service	Hand or swab	Crater No. 0 or 00
	Exposed to water	Hand or swab	Crater No. A or 1X
	Gasoline Engines		**See TEXACO LUBRICATION CHARTS**
	Diesel Engines		**See TEXACO LUBRICATION CHARTS**
	Steam Engines		
	Cylinders	Mechanical or Hydrostatic	Honor or Vanguard Cyl. Oil
	Bearings and guides	Sight feed oiler; hand oiled	Cetus or Alcaid Oil

Jack Frost
AND YOUR WIRE ROPE



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